

MKS

Instruction Manual



TYPE PDR-C-1C/2C POWER SUPPLY DIGITAL READOUT

WARRANTY NOTE

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SECTION 1

GENERAL DESCRIPTION

The PDR-C-1C and PDR-C-2C are power supply and digital readouts which are packaged in standard half-rack mount units. The PDR-C-2C is designed to provide power for, and accept the outputs from two pressure sensors. The PDR-C-1C is identical to the -2C except the -1C is designed for operation with one pressure sensor.

The power supply for both the -1C and -2C is capable of providing +/-15 VDC at up to 600 MA. This will provide enough power for two MKS Baratron TYPE 222B, 227A, 221, 224, 220B, 223B, or for any electronic manometer with similar input requirements.

The unit contains two setpoint-operated single pole relays which may be controlled by either pressure channel in the -2C. Setpoint adjustment is accomplished by front panel COARSE and FINE controls which cover the entire range of the gauge in use. The relays' status is indicated by front panel lamps. "Failsafe" relay operation is standard, i.e. the relays are not energized at pressures higher than the setpoint settings. The relays can be latched in the energized state by means of an external logic line to the rear panel interface connector.

The readout is a 4 1/2 place digital panel meter which indicates the output of the attached pressure sensor(s). Engineering units for the readout (mmHG, PSI, etc.) can be selected by a front panel switch. The meter also reads the current setpoint values in the same engineering units by means of another front panel switch. The PDR-C-2C has an additional front panel switch which is used to select display of channel 1, display of channel 2, remote channel selection, or automatic channel selection. In automatic channel selection, the PDR-C-2C will display Ch.1 sensor as long as it is less than 100%. If Ch.1 is greater than 100%, Ch. 2 will be displayed.

SPECIFICATIONS

Mechanical

Package: Standard 1/2 rack size cabinet

Weight: 7 lbs., 3.2 kg

Environmental

Max. Operating Temperature: 50 deg C (122 deg F)

Interface

All inputs/outputs and power supply are available on terminal blocks and other rear mounted connectors.

Electrical

Power Consumption: 65 Watts, full load

Operating Voltage: 117/234 +/- 15%, 50-60 Hz.

Power Supply Outputs: +/-15 volts @ 600mA, max ripple less than 10 mv.

Analog DC Outputs: 0-10 VDC into 10K ohms or greater,
0-1.999 VDC scaled output into 10K ohms or greater.

Display: 4 1/2 place, 7 segment planar LED, red.

Meter Accuracy: .01% of reading +/- 1 digit.

Input Impedance: 900K ohms

Zero Adjustment Range: +/-1.5% of full scale.

SET POINTS

Setpoint Relay Configuration: 2 separate circuits, on PDR-C-2C can be connected to either pressure channel with rear mounted toggle switches.

Contact Configuration: Single Pole Form C (SPDT) brought out to the rear panel. One for each setpoint.

Contact Rating: 2A @ 28 VDC, 1A @ 120 VAC resistive.

Setpoint Hysteresis: 0.5% of full scale.

SPECIFICATIONS (cont.)

Setpoint Adjustment Range: 100% of full scale (coarse and fine).

Relay Control: Digital Low on relay latch line holds the relay on once it has been energized.

BCD Outputs (optional): Tristate output parallel line BCD (1 TTL load each) TTL and CMOS compatible.

Specifications subject to change without notice.

SECTION 2

INSTALLATION

For information regarding the installation of the pressure gauge, refer to the manual for that specific instrument.

THE PDR-C-1C/2C MUST BE MOUNTED IN SUCH A MANNER AS TO PROVIDE ADEQUATE AIR CIRCULATION ABOUT THE UNIT.

In some cases the sensor cable attaches to the sensor with bare wires to a terminal block and in other cases the cable attaches to the sensor by a connector. MKS' standard color code for sensor cables follows:

+15 VDC Power Input.....	Green
-15 VDC Power Input.....	White
Pressure Input.....	Red
Power Ground (Return).....	Black
Signal Ground (Return).....	Black
Chassis (Case).....	Black (large)

GROUNDING:

The PDR-C-1C/2C has a three ground system which allows for the separation of the power supply return (D GND) and the DC output signal return (A GND) and the chassis ground. When used with pressure gauges that have only a two ground system, connect the D GND and A GND to that gauge's common ground and then connect the chassis ground of the PDR to the chassis ground of the gauge.

REAR PANEL CONNECTIONS AND CONTROLS (See Figure 1A & 2A)

A. PRESSURE GAUGE CONNECTOR(S):

These connectors are used to interface the PDR with the pressure gauge(s). They provide power to gauges requiring it, and receive the pressure signal back from the gauge.

B. DECIMAL POINT SELECTOR(S):

These are 4PST rocker switches used to set the display decimal point to the appropriate position for the pressure range being measured. The following chart shows switch settings for various full scale pressure values.

GAUGE F.S.	SWITCH SELECTION			
	1	2	3	4
1MM	ON	OFF	OFF	OFF
10MM	OFF	ON	OFF	OFF
100MM	OFF	OFF	ON	OFF
1000MM	OFF	OFF	OFF	ON
10000MM	OFF	OFF	OFF	OFF

Note: Closure of more than one switch (per channel) will produce multiple decimal points and interaction between channels.

C. POWER INTERFACE CONNECTOR:

This module accepts a standard power cord, and contains a line fuse, filter, and input voltage selector. The selected line voltage is visible on a small PC board mounted behind the plastic window. To change this voltage proceed as follows:

1. Remove the line cord and slide the plastic window to the left.
2. Pull the fuse lever outward to eject the fuse.
3. Insert a small probe in the hole in the PC card and remove the card.
4. Position the PC board so that the voltage desired is readable from the rear.
5. Plug the card back into the module, insert the proper value fuse (1 ASB @ 120 VAC or 1/2 ASB @ 240 VAC), slide the window to the right and plug in the line cord again.

D. INTERFACE CONNECTOR (J118):

This 20 pin connector is used for external access to the PDR. Set point relay connections (NC,NO,COMMON) are available on the connector as well as 0-10 volt full scale analog outputs which are equal to the incoming pressure signal including zero correction. Also available on this connector are the LATCH

control lines used to remotely hold the setpoint relays in the energized state, and a 0-1 volt analog output voltage line whose voltage is equal to the front panel display DVM input voltage. Analog and digital grounds are also brought out. The PDR-C-2C uses three additional lines; two for identification of which channel is currently being displayed and one line for remote selection of which channel is to be displayed. See Appendix 5-1 for the pinout of this connector.

E. BCD OUTPUT CONNECTOR (optional):

This connector provides 5 volt BCD logic lines directly from the front panel DVM. It is used for remote pressure reading and it outputs the same quantity as shown on the DVM. The BCD lines are updated approximately every .5 seconds, as is the display.

F. SETPOINT CHANNEL SELECT SWITCHES (PDR-C-2C only):

These switches are used to select which pressure signal is applied to each of the two setpoint comparators.

FRONT PANEL CONTROLS and INDICATORS (see Figures 1B & 2B)

G. POWER SWITCH:

Applies power to the PDR.

H. DISPLAY DVM:

A 4 1/2 place voltmeter which accepts 1.9999 volts full scale. This meter contains its own power supply, and provides display information in BCD form to the rear panel. Decimal point information for the display is obtained from rear panel range rocker switches and internal decoding circuits used in conjunction with the engineering units switch.

I. ZERO ADJUST CONTROL:

These controls are used as fine zero adjustments for the pressure gauge. An absolute pressure gauge must be pumped down below its resolution before this adjustment can be made; differential gauges should be cross-ported. The zero control on the pressure sensor is used as a coarse zero.

J. SETPOINT ADJUST CONTROLS:

These controls are used to adjust the desired setpoint level. Range is from 0 to 100% of the full scale pressure.

K. READ SETPOINT SWITCH:

This switch connects the pressure signal to the engineering units circuit and ultimately to the display when it is in the center position. When it is switched toward one side or the

other it connects the appropriate setpoint level through the engineering units circuit to the DVM. Thus the setpoint level is displayed in the same pressure units as the gauge being used. The switch is spring loaded to return to the center position when released.

L. SETPOINT RELAY INDICATOR LAMPS:

These LED's are illuminated when the setpoint relay is energized. This will occur when the pressure signal is below the setpoint value.

M. ENGINEERING UNITS SELECTION SWITCH:

This rotary switch is used for selecting which engineering units should be used with the front panel display. Changing this switch will automatically scale the display to the right value and move the decimal point to the appropriate location in the display.

N. X10-3 LAMP:

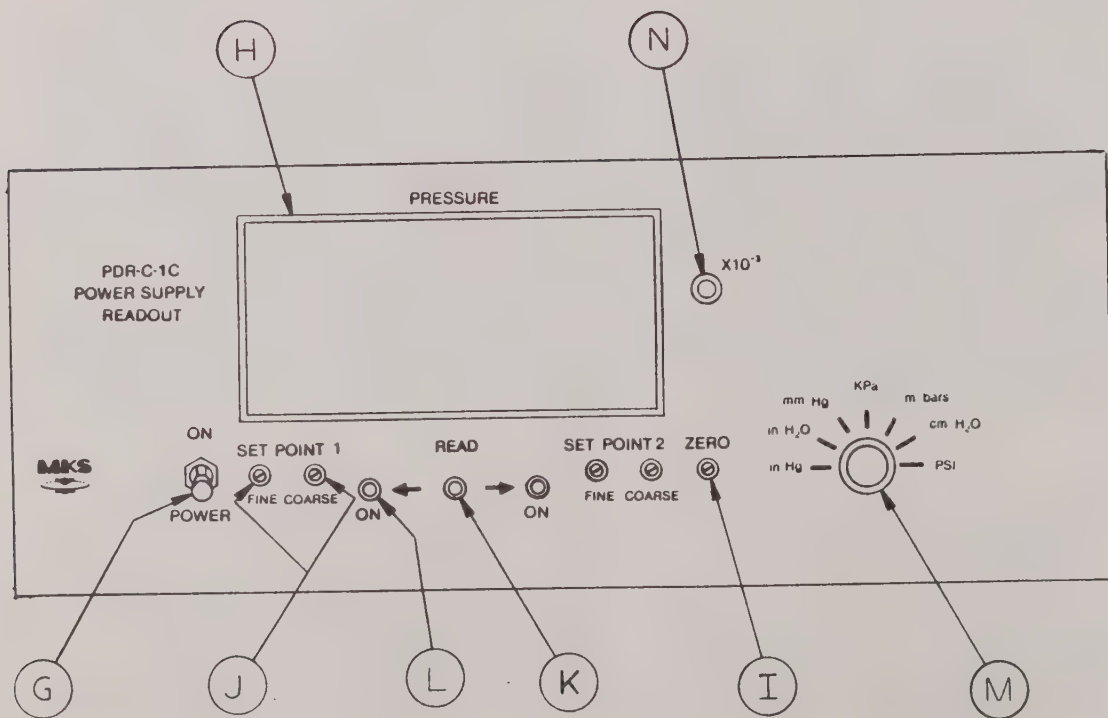
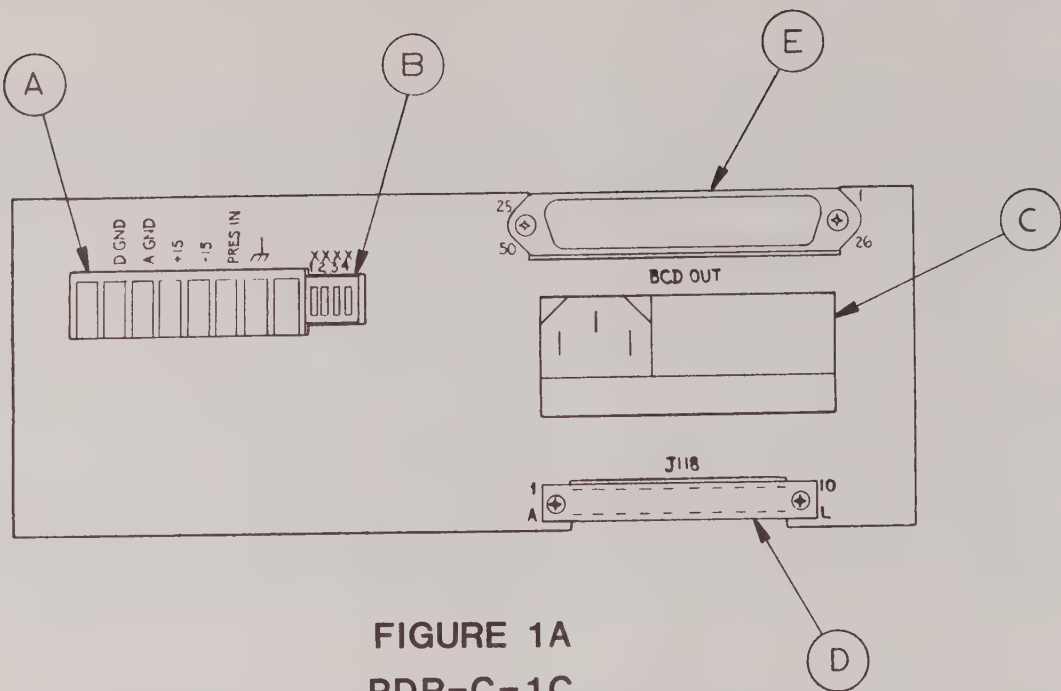
This LED indicates when the display is showing units requiring multiplication by 1/1000.

O. CHANNEL SELECT/REMOTE/AUTO SWITCH (PDR-C-2C only):

If set in either the "1" or "2" position, then the chosen channel's pressure value will be displayed (unless the READ switch is used).

If this switch is set to the "AUTO" position, then the display will monitor channel 2 at high pressures (it is assumed that channel 2 is connected to a sensor having higher range) until the pressure reading of channel 1's sensor falls to 90% of its full scale value. The display will continue to monitor channel 1 until channel 1's pressure reaches 100% of full scale of its pressure gauge, at which time it will automatically switch to monitoring channel 2.

If set for the "REMOTE" position, then an external 5 volt logic line may be used to select either channel 1 or 2 to be displayed. If a high signal is sent to this line, or if left unconnected, channel 1 will be selected. A low signal voltage will select channel 2.



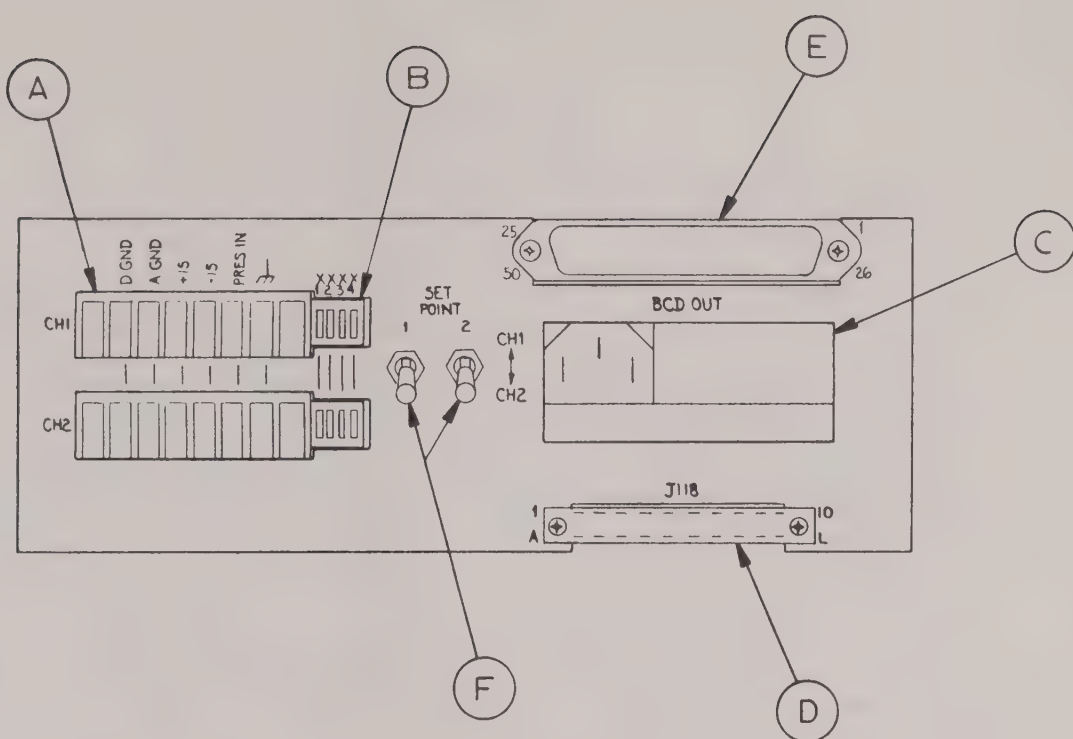


FIGURE 2A
PDR-C-2C

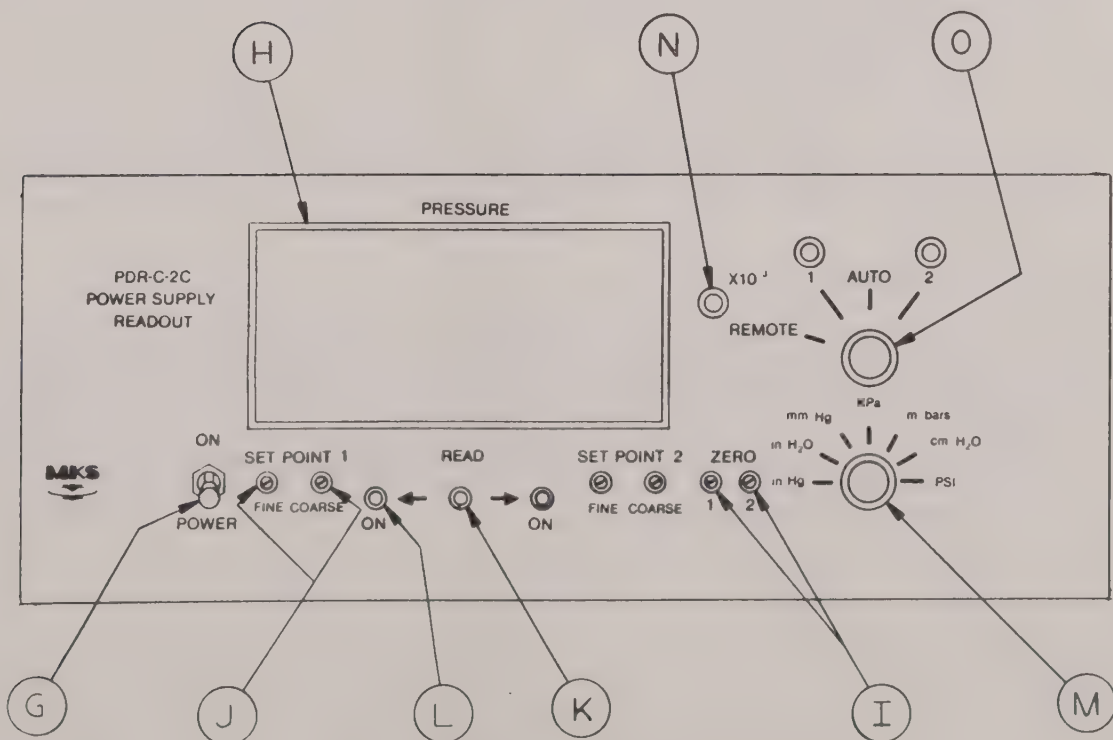


FIGURE 2B
PDR-C-2C

THEORY OF OPERATION

Refer to Figure 3 and Schematic.

PRESSURE SIGNAL:

The pressure signal is received from the pressure gauge at the rear panel terminal block and is applied to the input amplifier (U1) where the fine zero correction is added. The output from this amplifier then goes to the output buffer amplifiers (U2,U3) and to the rear panel interface connector. The output from U1 also goes to the set point switching circuits (through the rear panel Channel Select switches on the PDR-C-2C) and to the Engineering Units scaling circuit (through the DVM selection relay on the PDR-C-2C) which leads ultimately to the display DVM.

SET POINTS:

Two independant set point relays and their respective switching circuits are included in both the PDR-C-1C and -2C. In the -2C these set points can be selected to monitor either incoming pressure signal by means of rear panel channel selection switches. The set point circuit (U20,U16,U17,U18 and U19) compares the incoming pressure signal with an adjustable reference voltage which is set using the front panel Coarse and Fine adjustment controls. The relay logic is such that a no-power condition produces the same relay states that a high-pressure situation will produce. Either set point value may be read on the display DVM in engineering units by toggling the front panel READ switch toward the appropriate side.

OVER RANGE COMPARATOR:

This circuit (U15) monitors the input to the engineering units circuit and causes the display to blank when a pressure signal of approximately 11 or more volts occurs.

POWER SUPPLY:

The power supply provides ± 15 volts for internal circuits as well as for the attached pressure gauge. The + and - supplies are identical and are internally protected against shorts and overheating. This supply also generates the precision reference voltage used by the comparators. The display DVM provides its own +5 volt source which is also used as the supply for 5 volt logic on the main PC board.

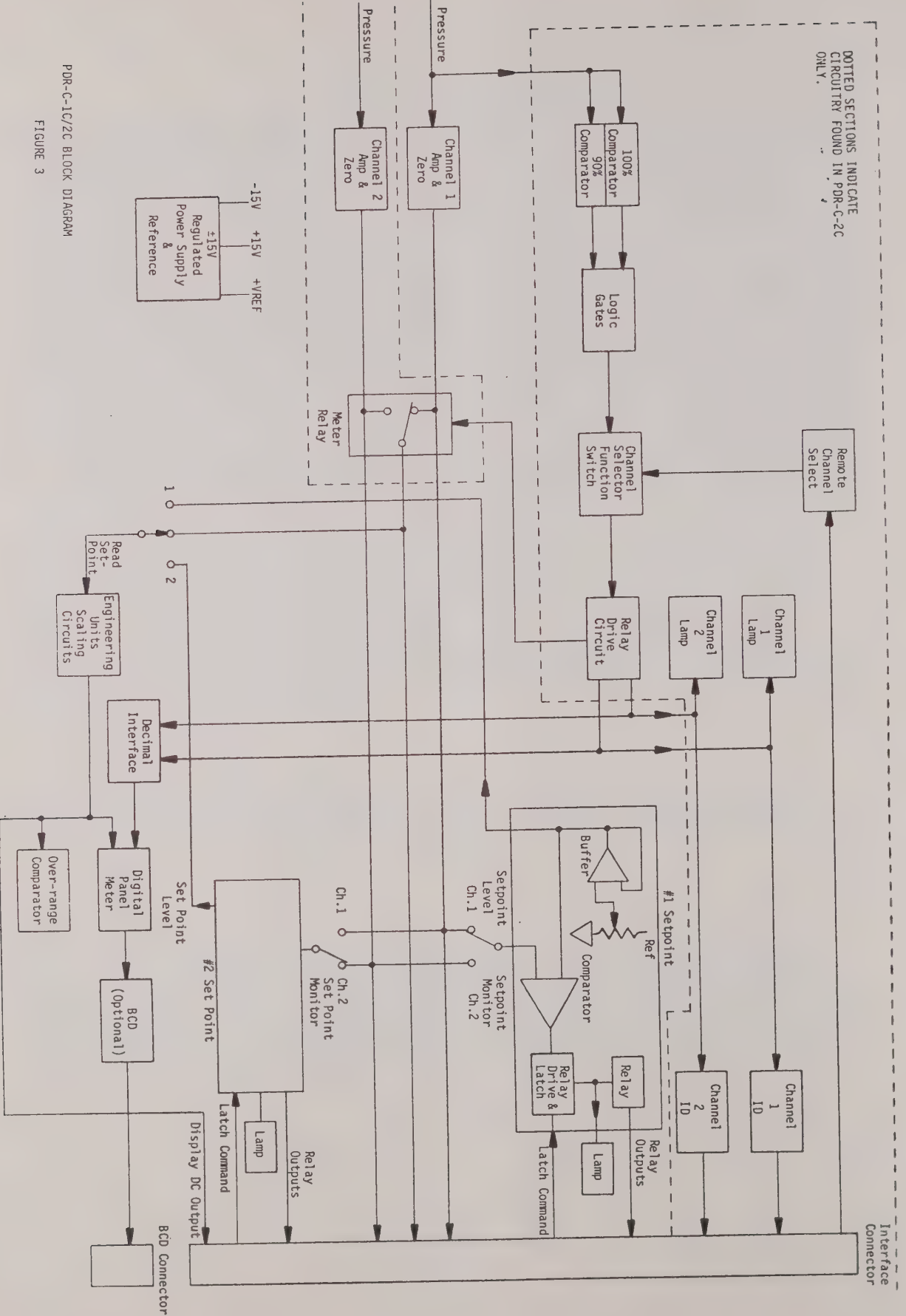
PRESSURE LEVEL COMPARATORS (PDR-C-2C only):

The channel 1 pressure signal is applied to two comparators (U4). One of these is set to trip at 90% of full scale pressure while the other is set for 100%. The comparator outputs are connected to logic whose output goes to the front panel Channel Selector/Function Switch.

Channel Selector/Function Switch (PDR-C-2C only):

This switch is used to determine which channel's output is displayed by the front panel DVM by choosing which logic level or input is applied to the channel select relay (K1). If the AUTO switch position is chosen then the logic output from the pressure level comparators is applied to the relay switching transistor (Q1). Front panel LEDs are used to indicate which channel is being displayed. When the Channel Selector/Function Switch is set to the REMOTE position the user can remotely select which channel is being displayed by inserting the appropriate logic level on pin C of the rear panel interface connector.

DOTTED SECTIONS INDICATE
CIRCUITRY FOUND IN PDR-C-2C
ONLY.



PDR-C-1C/2C BLOCK DIAGRAM

FIGURE 3

SECTION 4

MAINTENANCE AND TROUBLESHOOTING

GENERAL:

Should any difficulties be encountered in the use of your instrument, it is recommended that you contact any authorized MKS Sales Office or the Home Office for repair instructions.

If it is necessary to return the instrument to MKS for repair, please contact MKS' Customer Service Dept. at the Home Office for an ERA number (Equipment Return Authorization), to expedite handling and assure proper servicing of your instrument.

Should it become necessary to attempt repair in the field, the first step is to isolate the source of the problem to the pressure gauge or the PDR. Any repair made to the pressure gauge will usually require a recalibration. The PDR-C-1C/2C may be repaired without recalibration as long as none of the calibration adjustments have been tampered with.

FAULT ISOLATION:

The first step in troubleshooting is to isolate the problem to one of the sections of the PDR. Once this is done the problem can usually be easily located and corrected. The PDR-C-1C/2C can be broken down into the following sections:

- A. Power Supply
- B. Pressure Signal Amplification and Readout
- C. Set Point Circuits
- D. Channel Selection Circuits (PDR-C-2C only)

Since a problem in the power supply will effect the performance of all sections, it is important to begin fault isolation at this point.

A. Power Supply:

Measure the +/-15 volt supplies on the rear panel pressure gauge connector with respect to P GND. The voltages should be within the range of 14.8 to 15.2 volts and the AC ripple should be less than 10 mV P-P. If the voltages appear to be normal, then proceed to check the next section. If supply voltages are found to be not normal, disconnect the pressure gauge and retest the supply voltages. If the supplies now appear to be normal, the fault is with the pressure sensor. If the supplies are not normal after removing the pressure sensor, then remove the power supply jumpers (E1-E2 and E3-E4) in order to isolate the power supply from the rest of the PDR circuits. If the supplies now are normal, then the fault is probably a short circuit in the PDR circuits. If the supplies continue to appear abnormal, then refer to the schematic and continue to troubleshoot down to the component level.

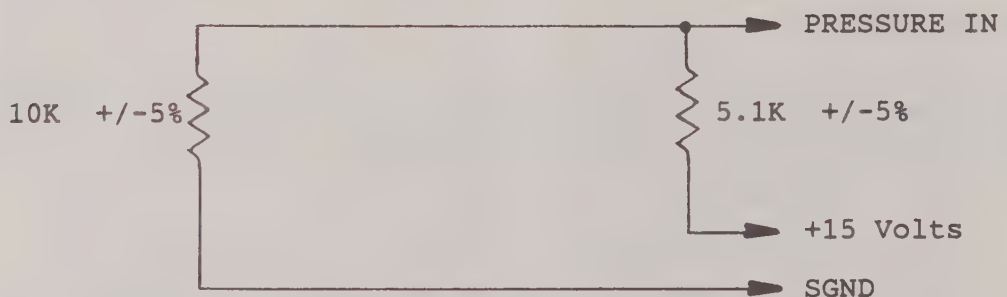
B. Pressure Signal Amplification and Readout:

Set up the PDR so that it is displaying the output from a connected pressure gauge. At the rear panel terminal block, connect an external voltmeter between Signal GND and the PRESSure INput. If this voltage closely tracks* ($\pm .2$ V) the voltage that is displayed on the front panel DVM but is not representing the correct pressure, then the pressure gauge is in error and the PDR is normal. If the voltage doesn't track then proceed.

* A voltage of above approximately 10.8 volts will cause the digital panel meter to overrange and blank, and this is to be considered normal.

To troubleshoot the signal path of the PDR-C-1C/2C, disconnect the pressure gauge and replace it with two resistors connected in the following manner:

(Connect to Channel 1 and place channel selector to Channel 1 in the PDR-C-2C)



This will produce an input voltage of +9.6 to +10.3 volts. To produce a zero input, simply short out the 10K Ω resistor. Set the front panel engineering units switch to the "mmHG" position. Use an external meter to measure the output voltage for this channel- (not the "DC OUTPUT"). Reference the meter to SGND on the input connector. The output voltage should track the input voltage developed by the above network to within $\pm .2$ volts. If not then the problem lies in the channel amplifier and zero circuit. Refer to the schematic and the circuits involving U1, U2 and U3 in order to troubleshoot to the appropriate component. If the voltage does track but the front panel DVM does not agree, the problem is with either the engineering units resistive divider (R43-R54), relay K1 (PDR-C-2C only), the front panel READ or engineering units switch, or buffer U8. Note that the DVM is 1.9999 volts full scale and will read out 1/10 of the incoming signal voltage when set to the "mmHG" position (ignoring decimal point).

1. Calibration of Engineering Units Circuit

Equipment Required: 1 DVM, 5 1/2 place
1 Precision Variable Voltage Source,
10 volt
Misc. Bus Wire
Schematic
PC Layout

With power off, short the Pressure Input to the Signal GND terminal on the PDR rear panel terminal block (CH 1). Attach the DVM between Analog GND and the zeroed CH 1 signal available at front panel switch S3 or at one end of R43. Apply power to the PDR and adjust the front panel ZERO trimmer for a 0.000+/- .0005 volt DVM reading. Shut off power to the PDR and attach the voltage source between the Pressure Input and Signal GND terminals. Apply power and a voltage source of 10.0000 +/- .0005 volts, as measured by the DVM. Ignoring the decimal point on the front panel display, use the following chart to set the appropriate trimmer for a correct display of the chosen engineering units.

UNITS	TRIMMER	FRONT PANEL DVM
PSI	R44	19337
cmH2O	R55	13597
mbar	R47	13332
KPa	R47	13332
mmHG	R49	10000
inH2O	R51	5353
inHg	R53	3937

C. Setpoints:

With the input section zeroed and 10 volts input applied as described above in "Calibration of Engineering Units" (place PDR-C-2C rear panel SETPOINT switches in "CH 1" position), check voltages at U20 pin 5 and U16 pin 3 to be 10.000 volts. If not, check continuity from R5 and R6 through jumpers E7-E8 and E9-E10 (PDR-C-1C) or through rear panel switches S7 and S8 (PDR-C-2C). If 10 volts is read at U20 and U16 then check the voltage at U20 pin 3 and verify it with the front panel DVM, with engineering units set to "mmHG". Do this by moving the front panel SETPOINT switch to the left for CH 1. Similarly check U16 pin 5 to be the same as the front panel display with the SETPOINT switch to the right (CH2). Varying the COARSE and FINE setpoint trimmers should vary the display voltages accordingly. By changing the incoming "pressure" signal from the voltage source to be close to

the setpoint voltage, the outputs of both setpoint comparators (U18A pin 1 and U18B pin 7) should switch between the positive and negative supply rails. This in turn should cause U17 pins 10 and 4 to vary inversely between 0 volts and the positive supply (be sure the LATCH lines are in a high state-U17 pin 12 and pin 1). Next check the outputs from U19 pins 1 and 7 to ensure switching between rails. If the above all works, any problem must be with the relay drivers Q5 and Q6 or relays K2 and K3 and associated components.

D. Channel Selection Circuits (PDR-C-2C only)

If no channel selection is indicated, check J113 pin 2 to be connected to digital ground and J113 pin 1 to be +5 volts. If digital ground is at fault, check continuity back to the power supply. If +5 volts is at fault, check wiring from the front panel DVM (+5 volt supply comes from the DVM!). If both are O.K. and no channel switching occurs, check the collector voltages of Q1 and Q2 to verify that one is at 0 volts and the other is at +15 volts. If this is O.K. check that relay K1 is switching when changing channel selection from CH 1 to CH 2 and back. If remote channel selection malfunctions, check U6 pin 4 to be switching inversely to an applied +5 volt logic signal on rear panel connector J118 pin C.

If problems exist with the AUTOMATIC channel selection circuit, first select AUTO operation and attach the voltage source to channel 1 Pressure Input as previously described. While monitoring the voltage at U4 pin 1, vary the incoming voltage from approximately 8 volts up to 11 volts noting that U4 pin 1 should switch high at approximately 10 volts input. If not, check circuit or adjust R16. Next do the same test while monitoring U4 pin 7, noting that switching should occur with approximately 9 volts input. If this all checks out, next measure U5 pin 4 to be switching high at approximately 10 volts as the input increases from 8 volts. Next decrease from 11 volts and note U5 pin 4 to be switching low as the input voltage equals approximately 9 volts. If this is happening and automatic channel selection is not occurring, then the relay (K1) driver circuits are at fault.

SECTION 5

APPENDIX

Remote Channel Select/Setpoint Interface Connector (J118)

Pin #	Description
1	Signal GND
2	Digital GND
3	N/C
4	Switched DC Output (in engineering units)
5	N/C
6	Latch #2 Setpoint Relay (active low)
7	Latch #1 Setpoint Relay (active low)
8	Setpoint #1 Relay NO Contact
9	Setpoint #1 Relay NC Contact
10	Setpoint #1 Relay C Contact
A	Channel 1 Range ID (*see note below)
B	Channel 2 Range ID (*see note below)
C	Remote channel Select
D	N/C
E	N/C
F	CH 2 DC Output (0-10 volts, zero corrected)
H	CH 1 DC Output (0-10 volts, zero corrected)
J	Setpoint #2 Relay NC Contact
K	Setpoint #2 Relay NO Contact
L	Setpoint #2 Relay C Contact

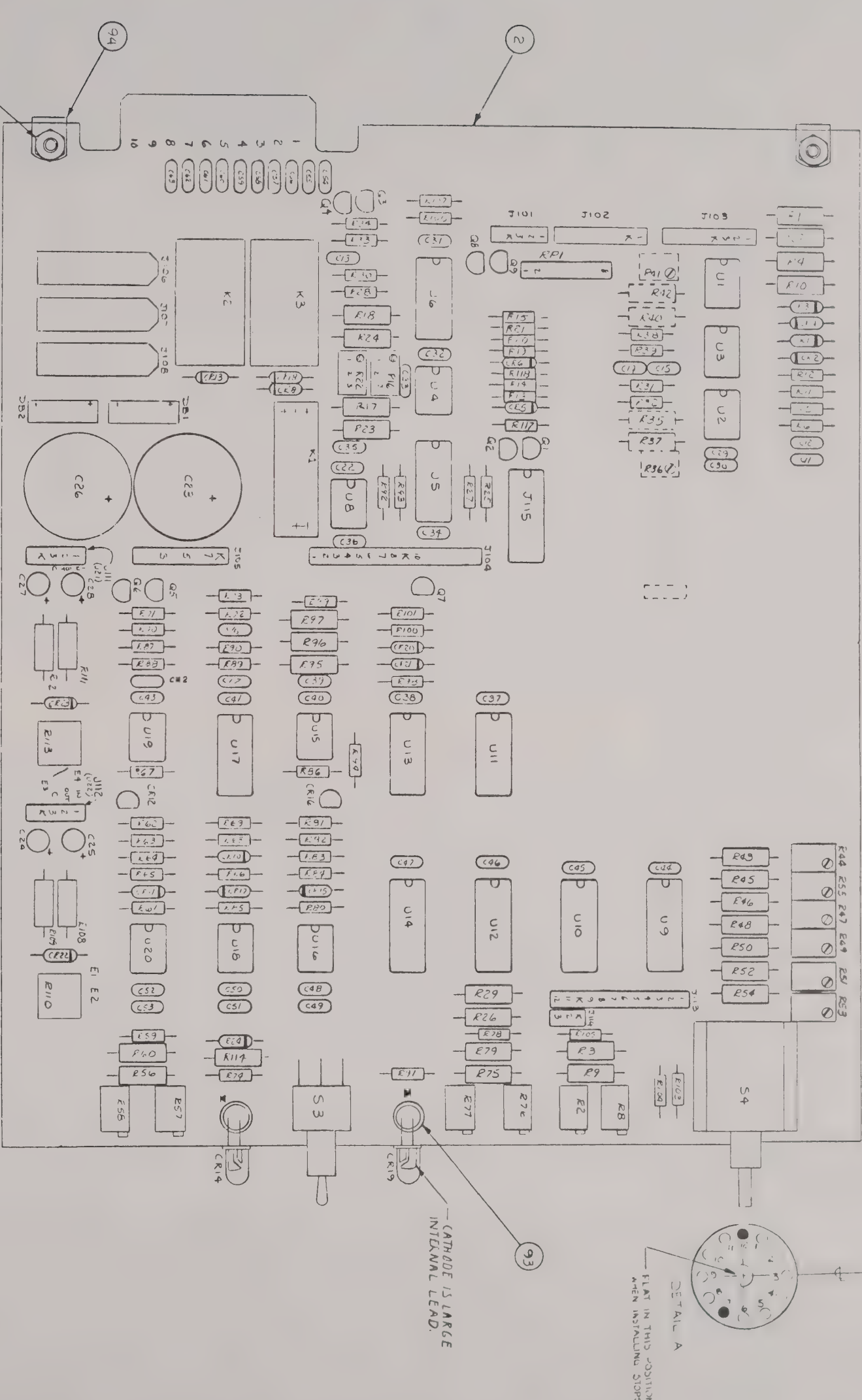
* Transistor open collector will sink 10ma @0.4 volts. Maximum off voltage (VCEO) is 25 volts.

BCD OPTION

This option provides a latched and buffered BCD output at the rear panel. The BCD information is enabled or disabled by six control lines. When these lines are tied together and connected to digital ground all of the BCD information is present at the rear connector and can be read when the READ COMMAND goes high. When these lines are open then all of the BCD lines are open. This is done so that several meters can be connected to a common bus and strobed for a reading by grounding the appropriate control lines. The BCD outputs can be interfaced to a computer or digital printer. The pinout of the rear panel connector is shown below.

BCD DATA		PIN#	BCD DATA		PIN#
1		8	10000		5
2	DIGIT 1	36	POLARITY		27
4		38	OVERRANGE		26
8		40	ENABLE DIGIT 5		31
	ENABLE DIGIT 1	17	ENABLE REMAINDER		34
10		16			3
20	DIGIT 2	14	DIGITAL COMMON		28
40		12			4
80		35			
	ENABLE DIGIT 2	7	DATA READY		30
100		10	+3P		22
200	DIGIT 3	11	+2P		23
400		13	+1P		44
800		42	0P		45
	ENABLE DIGIT 3	41	-1P		47
			-2P		48
1000		15			
2000	DIGIT 4	39			
4000		37			
8000		33			
	ENABLE DIGIT 4	32			

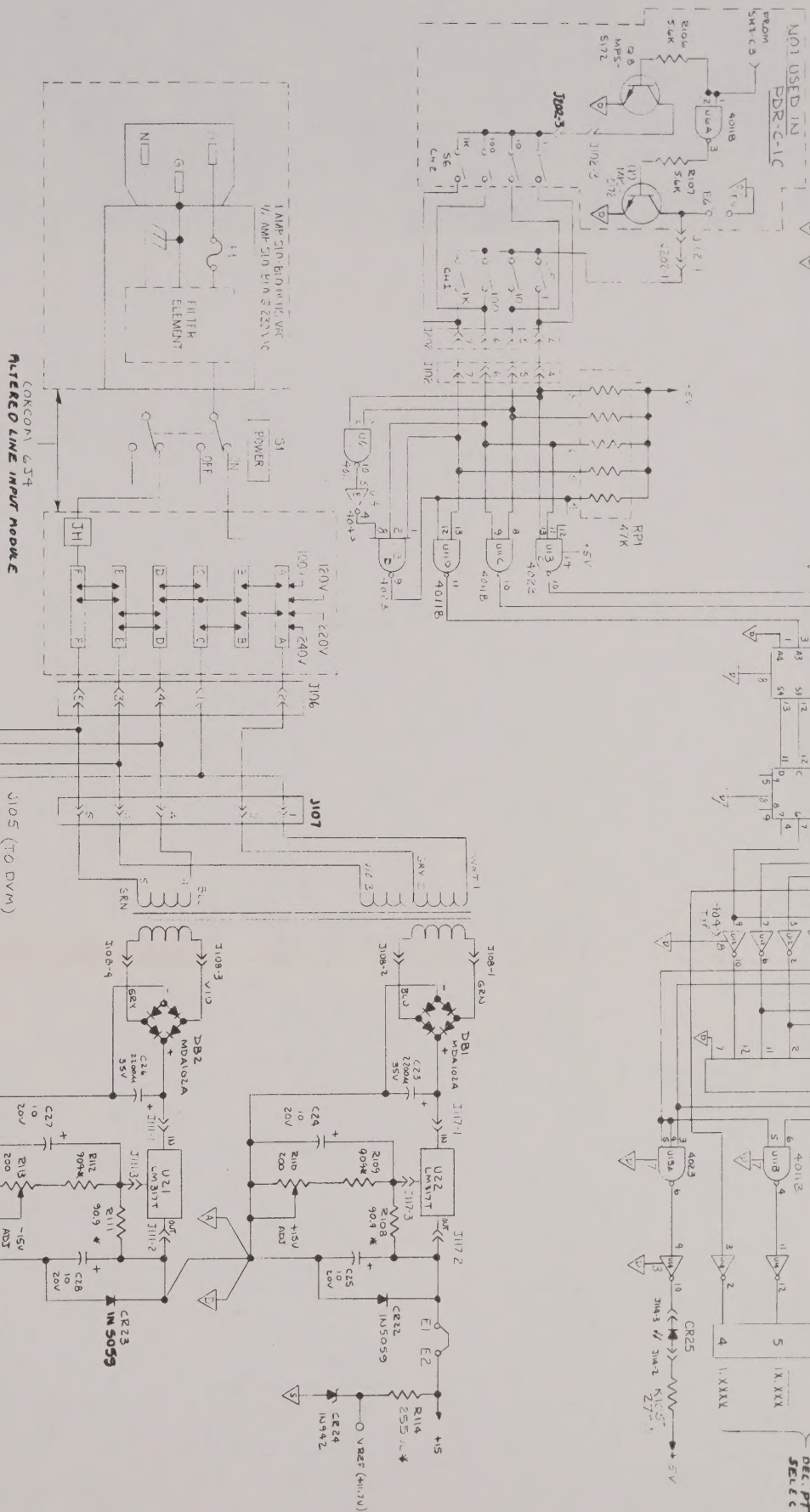
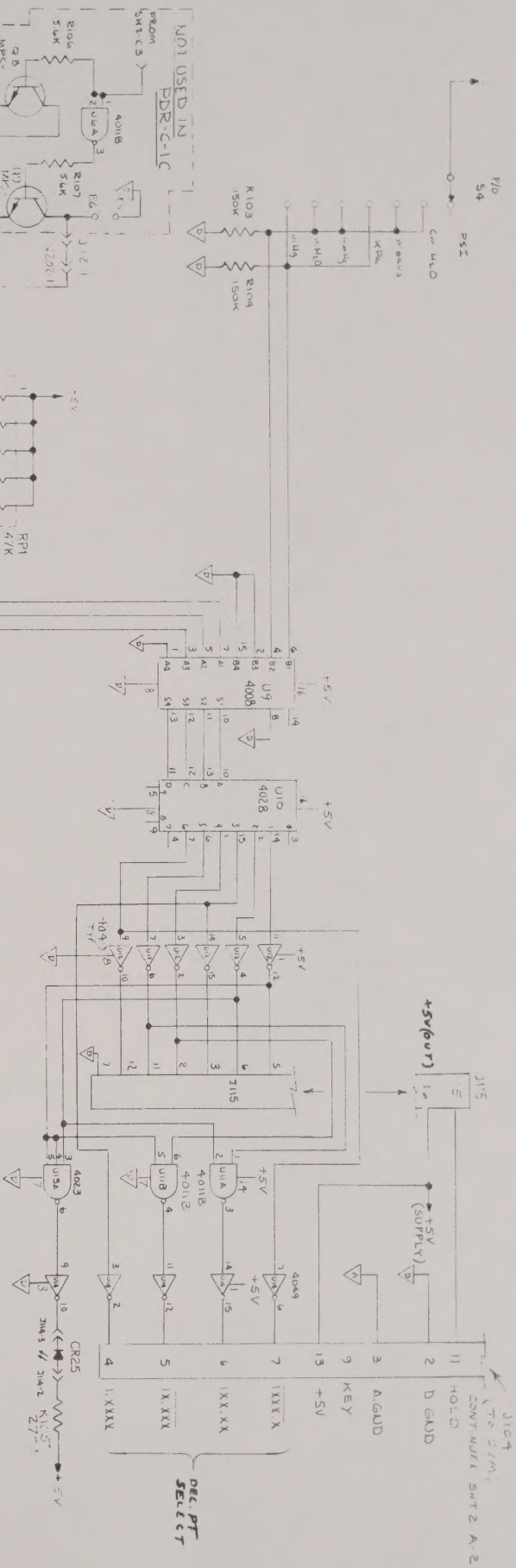
NOTE: THE BCD CONNECTOR PINOUT FOR THE PDR-C-1C/2C IS COMPLETELY DIFFERENT FROM THE PREVIOUS BCD PINOUTS OF EITHER THE PDR-C-2 OR THE PDR-C-1B. AS A RESULT, CABLING WHICH IS COMPATIBLE WITH PREVIOUS PDR'S WILL NOT WORK WITH THE PDR-C-1C/2C.



NOTE

THE FOLLOWING COMPONENTS ARE FOR SIGNAL APPLICATION ONLY:
R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99 R100

MAIN BOARD
D109108-D

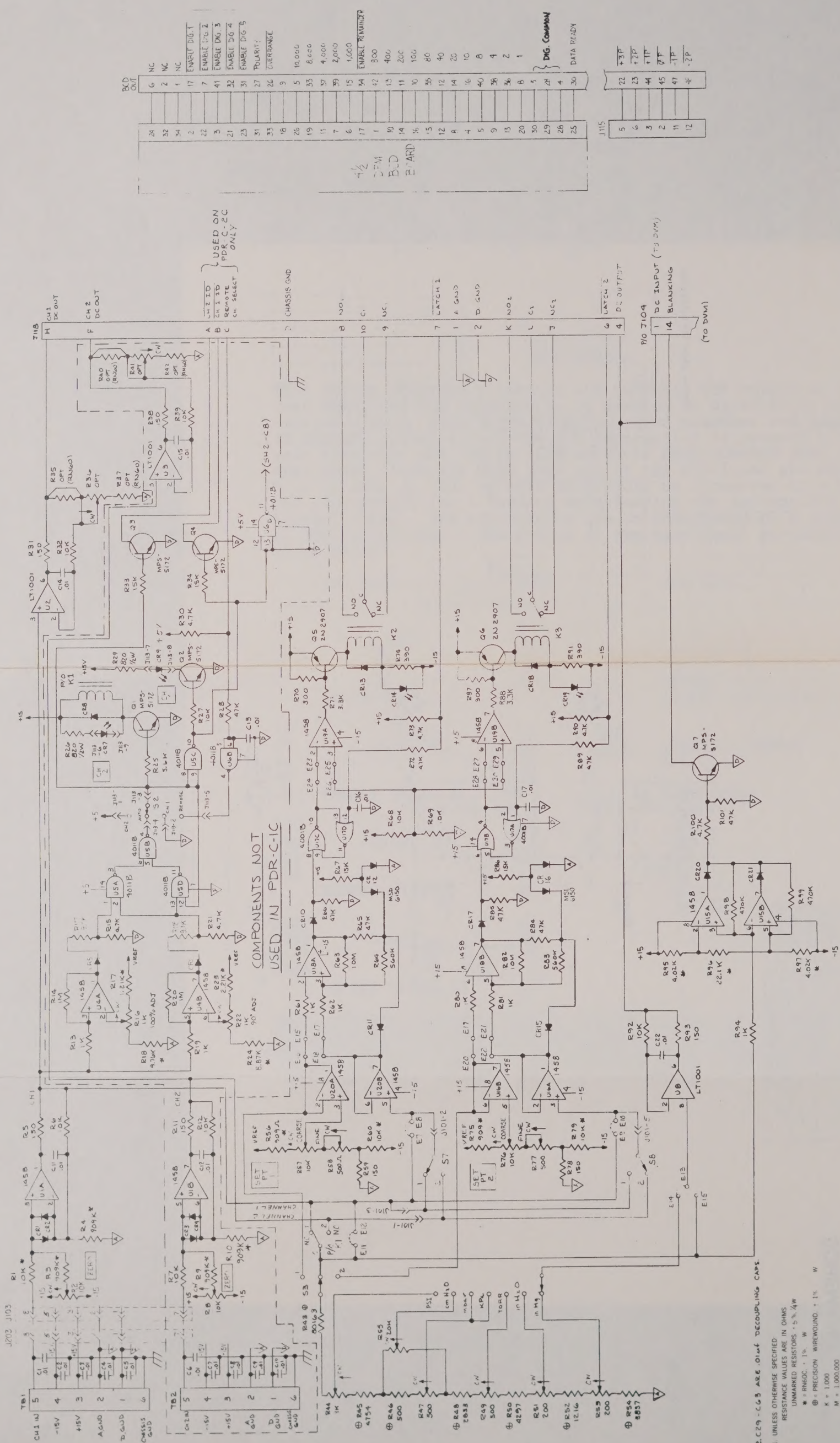


UNLESS OTHERWISE SPECIFIED
RESISTANCE VALUES ARE IN OHMS
UNMARKED RESISTORS - 1/4 W
* - RNIC - 1/4 W
@ - PRECISION WIREWOUND - 1/4 W
K = 1000
M = 1,000,000
CAPACITANCE VALUES ARE IN MICROFARADS
P - PICOFARADS
INDUCTANCE VALUES ARE IN MICROHENRIES
DIMENSIONS ARE IN INCHES

NOTES

REFERENCE DATA		
DESCRIPTION	LAST NO.	DELETED NOS.
RESISTOR	R1P	R1, R1P, R1P, R1P
CAPACITOR	C1, C2	C1, C1P, C2, C2P
DIODE	CR24	CR24
TRANSISTOR	Q1	Q1
IC	U22	U22

SCHEMATIC
D109161-E



2. C29-C63 ARE 0.01μF DECOUPLING CAPS.
 1. UNLESS OTHERWISE SPECIFIED
 RESISTANCE VALUES ARE IN OHMS
 UNMARKED RESISTORS ± 5% 1/4W
 * = 1% 1/4W
 † = PRECISION WIREWOUND ± 1% 1/4W
 K = 1,000
 M = 1,000,000
 CAPACITANCE VALUES ARE IN MICROFARADS
 PF = PICOFARADS
 INDUCTANCE VALUES ARE IN MICROHENRIES
 DIODES ARE 1N4148

NOTES

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